Ultra-High Precision Measurements of Greenhouse Gas Stable Isotope Ratios

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The official link for this solicitation is:
https://www.fbo.gov/index?s=opportunity&mode=form&id=35d644c4794ce7203151552e947505d3&tab=core&_cview=1

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Department of Commerce

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Description:

Summary: Atmospheric carbon dioxide (CO2) and methane (CH4) are the dominant contributors to global radiative forcing, and monitoring their concentrations is vital for understanding changes in Earth's climate. Interpreting variations of atmospheric CO2 and CH4 allow sources and sinks of carbon to be determined. Currently, ultra-high precision laboratory-based measurements for CO2 and CH4 using isotope ratio mass spectrometers exist. These devices are labor intensive and require significant pre-processing of samples. Direct optical methods (i.e. spectroscopy) have potential to greatly streamline this process if small volumes can be used and measurements can be made with as good or better precision and stability than existing mass spectrometric techniques. Instruments with such high precisions are not currently available in the marketplace. Instrument developers should aim for measurements of CO2 and CH4 isotope ratios that achieve the needed repeatability (δ13C CO2: 0.01 per mil, δ18O CO2: 0.02 per mil, δ13C CH4: 0.1 per mil, or δ2H CH4: 0.5 per mil) using < 600 mL of air [standard temperature and pressure (STP)] in less than 15 minutes. Note that the requirements pertain to only a single isotopomer, i.e., a single instrument capable of achieving precision (repeatability) for multiple isotopomers is a benefit but is not required.

Project Goals: The short-term goal of this project is to design a cost-effective and ideally, but not

necessarily portable (adequate for field deployment) ultra-high precision instrument to measure isotopic composition of greenhouse gases in a way that significantly improves on the currently slow and labor intensive techniques while maintaining or exceeding currently achieved precision.

The long-term goal is performing isotopic measurements on a routine and large-scale basis for the purpose of attributing sources of carbon in the atmosphere. Assessing the isotopic composition of measured greenhouse gases is one of the most accurate techniques to identify their origin, whether they are emitted by biogenic or anthropogenic activities (e.g., combustion, fires, biological activity, air-sea gas exchange).

Phase I Activities and Expected Deliverables:
• Develop conceptual methodology
• Verify methodology
• Investigate and identify appropriate components
• Design bench-level prototype

Phase II Activities and Expected Deliverables:
• Purchase components
• Integrate components
• Construct working bench-level prototype
• Perform initial bench testing
• Iteratively test and refine the original design as necessary
• Integrate the prototype into a laboratory setting
• Provide verification of data quality in cooperation with NOAA laboratories